We claim:

1. A hydraulic holder comprising:

(a) a shank for mating engagement with a rotating machining device;

(b) a nosepiece in axial alignment with the shank having an axial bore; and

(c) a hydraulic cartridge fixedly mounted in the bore, whereby the hydraulic cartridge may be actuated to clamp a tool or a workpiece in the inner bore of the cartridge.

2. A hydraulic cartridge comprising:

(a) a cartridge shell;

(b) surrounding a cartridge body;

(c) the cartridge body having a hydraulic circuit filled with hydraulic fluid, a means of compressing the hydraulic fluid within the hydraulic circuit, and a deformable inner wall surrounding an inner bore so that upon compression of the hydraulic fluid within the hydraulic circuit the inner wall deforms into the inner bore for mating engagement with a tool or workpiece within the inner bore.

3. A hydraulic holder comprising:

(a) a shank for mating engagement with a rotating machining device;

(b) a nosepiece in axial alignment with the shank having an axial bore and a first actuator access port;

(c) a cartridge inserted into the axial bore of the nosepiece;

(d) the cartridge having a body and a shell surrounding the body;

(e) the shell having a second actuator access port in radial alignment with the first actuator access port;

(f) the body having a hydraulic circuit filled with hydraulic fluid, the hydraulic circuit having a piston in a piston cylinder which piston cylinder is in radial alignment with the first and second actuator access ports whereby longitudinal movement of the piston into the piston cylinder compresses the hydraulic fluid against a deformable inner wall surrounding an inner bore which inner bore is configured for mating engagement with an inserted tool or workpiece, and the tool or workpiece is clamped in the inner bore by compression of the deformable wall by the hydraulic fluid.

4. The cartridge of claim 2, wherein the means for compression of the hydraulic fluid within the cartridge is:

(a) an actuator access port in the cartridge shell and

(b) a piston in a piston cylinder which piston cylinder is in radial alignment with the actuator access port in the cartridge shell whereby longitudinal movement of the piston into the piston cylinder compresses the hydraulic fluid within the cartridge.

5. The hydraulic holder of claim 1, further comprising:

(a) a first actuator access port in the nosepiece of the holder;

(b) a second actuator access port in a cartridge shell in radial alignment with the first actuator access port;

(c) a cartridge body fluid tightly affixed in the cartridge shell;

(d) the cartridge body having (i) a piston cylinder in radial alignment with the first actuator access port and the second actuator access port, (ii) a first annular positioning ring with the piston cylinder extending radially through the first annular positioning ring and at least one channel disposed longitudinally in the first annular positioning ring and in communication with the piston cylinder and with an upper clamping band, (iii) a first end of the upper clamping band adjacent the first annular positioning ring and surrounding a portion of a deformable inner wall, (iv) a second annular positioning ring adjacent a second end of the upper clamping band and surrounding a portion of the inner wall, the second annular positioning ring having at least one longitudinally disposed clamping channel, (v) a lower clamping band with a first end of the lower clamping band adjacent the second annular positioning ring and the lower clamping band surrounding a portion of the inner wall that is deformable, (vi) a third annular positioning ring adjacent a second end of the lower clamping band and surrounding a portion of the inner wall, (vii) the inner wall surrounding and forming an inner bore, (viii) an actuator adjustable

radially through the first annular positioning ring, a piston moveable by the actuator, and a seal moveable by the piston through a seal displacement range, the actuator, piston, and seal in radial alignment with one another in the piston cylinder so that the seal is proximate to the at least one channel, and (ix) hydraulic fluid filling the portion of the piston cylinder proximate the seal, at least one channel, the upper clamping band, the at least one clamping channel, and the lower clamping band.

6. An apparatus for clamping a tool or workpiece in a rotating machining device, comprising:

(a) a shank for mating engagement with a rotating machining device having an axial bore therein;

(b) a hydraulic cartridge fixedly engaged in the bore of the shank, for clamping a tool or workpiece in the inner bore of the cartridge.

7. An apparatus for clamping a tool or workpiece in a rotating machining device, comprising:

(a) a shank for mating engagement with a rotating machining device;

(b) a nosepiece affixed in axial alignment to the shank having an axial bore therein; and

(c) a hydraulic cartridge fixedly engaged in the bore of the nosepiece, for clamping a tool or workpiece in the inner bore of the cartridge.

8. The apparatus of claim 7, further comprising:

(a) a first actuator access port in the nosepiece;

(b) a second actuator access port in a cartridge shell in radial alignment with the first access port in the nosepiece;

(c) a cartridge body affixed fluid tight in the cartridge shell; and

(d) the cartridge body having (i) a piston cylinder in axial alignment with the first and second actuator access ports, (ii) a first annular positioning ring having the piston cylinder extending radially through the first annular positioning ring and at least one channel disposed longitudinally in the first annular positioning ring and in communication with the piston cylinder, (iii) an upper clamping band with a first end of the upper clamping band adjacent the first annular positioning ring and surrounding a portion of a deformable inner wall, (iv) a second annular positioning ring adjacent a second end of the upper clamping band, surrounding a portion of the inner wall, and having at least one longitudinally disposed clamping channel, (v) a lower clamping band with a first end of the lower clamping band adjacent the second annular positioning ring and surrounding a portion of the inner wall that is deformable, (vi) a third annular positioning ring adjacent a second end of the lower clamping band and surrounding a portion of the inner wall, (vii) the inner wall surrounding and forming a tool inner bore, (viii) an actuator adjustable radially through the first annular positioning ring, a piston moveable by the actuator, and a seal moveable by the piston through a seal displacement range, the actuator, piston, and

seal in axial alignment with one another in the piston cylinder so that the seal is proximate to the at least one channel, and (ix) hydraulic fluid filling the portion of the piston cylinder proximate the seal, the at least one channel, the upper clamping band, the at least one clamping channel, and the lower clamping band.

9. The hydraulic toolholder of claim 1, wherein the hydraulic circuit comprises:

(a) a piston cylinder;

(b) a first annular positioning ring with the piston cylinder extending radially through the first annular positioning ring and at least one channel disposed longitudinally in the first annular positioning ring in communication with the piston cylinder;

(c) a clamping band with a first end of the clamping band adjacent the first annular positioning ring, the clamping band surrounding a portion of a deformable inner wall, and the first end of the clamping band in communication with the at least one channel;

(d) a second annular positioning ring adjacent a second end of the clamping band, the annular positioning ring surrounding a portion of the inner wall, and

(e) the inner wall surrounding and forming a tool inner bore.

10. A hydraulic holder comprising:

(a) a toolholder having a hydraulic circuit in a toolholder bore wall;

(b) a deformable inner cartridge shell affixed fluid tight around the toolholder bore wall; and

(c) hydraulic fluid in the hydraulic circuit and a means for compressing the hydraulic fluid in the hydraulic circuit to deform the inner cartridge shell inwardly to matingly engage a tool or workpiece located within the inner bore of the inner cartridge shell.

11. A hydraulic toolholder comprising:

(a) a toolholder having a hydraulic circuit in a nosepiece outside wall;

(b) a deformable outer cartridge shell affixed fluid tight around the nosepiece outside wall; and

(c) hydraulic fluid in the hydraulic circuit and a means for compressing the hydraulic fluid in the hydraulic circuit to deform the outer cartridge outwardly to matingly engage the bore of a tool or workpiece located around the outer cartridge shell.

12. A mandrel cartridge comprising:

(a) a deformable outer cartridge shell;

(b) surrounding a mandrel cartridge body;

(c) the mandrel cartridge body having a hydraulic circuit filled with hydraulic fluid, a means of displacing the hydraulic fluid within the hydraulic circuit, so that upon compression of the hydraulic fluid within the

hydraulic circuit the deformable outer cartridge shell deforms outwardly for mating engagement with a bore in a tool or workpiece.

13. The mandrel cartridge of claim 12, also comprising a shank affixed to a first end of the mandrel cartridge in axial alignment with the first end of the mandrel cartridge shell.

14. A hydraulic mandrel holder comprising:

(a) a shank portion;

(b) a cylindrical end affixed to the shank portion in axial alignment with the shank portion;

(c) a mandrel cartridge having a deformable outer cartridge shell, a cartridge body, at least one deformable inner wall portion, and a cylindrical end bore, defined by the deformable inner wall in the cartridge body, in mating engagement with the cylindrical end;

the cartridge body having a hydraulic circuit filled with hydraulic fluid and a means of compressing the hydraulic fluid within the hydraulic circuit, so that upon compression of the hydraulic fluid within the hydraulic circuit (i) the inner wall deforms inwardly for releasable fixed mating engagement with the cylindrical end and (ii) the deformable outer cartridge shell deforms outwardly for releasable fixed mating engagement with a bore in a tool or workpiece.

15. The process of removing air or excess hydraulic fluid from the hydraulic circuit of the hydraulic cartridge of claims 1 through 14, comprising the steps of:

(a) filling the hydraulic cartridge with hydraulic fluid through the piston cylinder;

(b) inserting a seal into the piston cylinder to the desired depth in the piston cylinder so that any air or excess hydraulic fluid will escape through an oil/air escape through-hole in the seal; and

(c) inserting a piston into the piston bore in axial alignment with the seal, so that a piston pin is matingly inserted into the oil/air escape through-hole in the seal.

16. The process of removing air or excess hydraulic fluid from the hydraulic circuit of the hydraulic cartridge of claim 15, further comprising the steps of:

(a) first inserting an insertion tube of an insertion tool into the oil/air escape through-hole in the seal and then, using the insertion tube, moving the seal in the piston cylinder to the desired depth in the piston cylinder, whereby any air or excess hydraulic fluid will escape into the bore of the insertion tube and out the through pipe of the insertion tool; and

(b) removing the insertion tool with its insertion tube from the piston cylinder and oil/air escape through-hole.

17. The process of filling the hydraulic circuit of the hydraulic cartridge of claims 1 through 14, comprising the steps of:

(a) placing the hydraulic cartridge in a air evacuation chamber;

(b) raising the piston cylinder end of the hydraulic cartridge above the opposite end of the hydraulic cartridge with the piston cylinder directed upwardly;

(c) lowering the pressure in the chamber to less than ambient pressure;

(d) filling the hydraulic cartridge through the piston cylinder;

(e) after the piston cylinder is full of hydraulic fluid and air ceases to exit through the piston cylinder, inserting a seal into the piston cylinder to the desired depth in the piston cylinder, whereby hydraulic fluid in the piston cylinder that is displaced by insertion of the seal escapes out of the oil/air escape tube; and

(f) removing the insertion tool and inserting a piston pin of a piston into the seal.

18. A method of retro-fitting a hydraulic toolholder having an intregral hydraulic circuit with a piston cylinder, seal, piston, and actuator, comprising the steps of:

(a) drilling a piston cylinder along a transverse axis of the nosepiece so that the piston cylinder intersects with the hydraulic circuit;

(b) filling the hydraulic circuit with hydraulic fluid;

(c) inserting a seal into the piston cylinder to the desired depth, whereby some of the hydraulic fluid escapes out of the seal oil/air escape through hole;

(d) inserting a piston into the piston cylinder so that the piston pin mates with the oil/air escape through hole in the seal; and

(e) inserting an actuator into the piston cylinder.

19. A hydraulic cartridge comprising:

(a) deformable cartridge shell, having an actuator access port, the cartridge shell surrounding a cartridge body;

(b) the cartridge body having (i) a piston cylinder in alignment with the actuator access port, (ii) the piston cylinder extending into a first annular positioning ring, (iii) at least one fill/bleed channel disposed longitudinally in the first annular positioning ring and the at least one fill/bleed channel in communication with the piston cylinder and with a clamping band, (iv) the first annular positioning ring adjacent a first end of the clamping band, (v) a second end of the clamping band adjacent a second annular positioning ring, (vi) the clamping band surrounding at least a portion of that portion of the inner wall of the cartridge body that is deformable and surrounding a portion of the cartridge shell, (vii) the inner wall surrounding and forming an inner bore in axial alignment with the cartridge body, (viii) an actuator adjustable into the piston cylinder, a piston moveable by the actuator, and a seal moveable by the piston through a seal displacement range, the

actuator, piston, and seal in axial alignment with one another in the piston cylinder with the seal proximate to the at least one fill/bleed channel, and (ix) a hydraulic circuit filled with hydraulic fluid, the hydraulic circuit comprised of the space bounded by that portion of the piston cylinder proximate a seat of the seal, the at least one fill/bleed channel, the first annual positioning ring, the cartridge shell, the inner wall, and the second annual positioning ring, so that upon compression of the hydraulic fluid, by actuation of the actuator, piston, and seal combination, within the piston cylinder so that at least that portion of the inner wall that is deformable deforms and the cartridge shell deforms for mating engagement with a tool or workpiece.

20. The hydraulic cartridge of claim 19, wherein the cartridge shell is rigid, so that upon compression of the hydraulic fluid at least that portion of the inner wall that is deformable deforms for mating engagement with a tool or workpiece in the inner bore.

21. The hydraulic cartridge of claim 19, wherein the hydraulic circuit is formed in a solid cartridge body, the hydraulic circuit comprised of the space bounded by that portion of the piston cylinder proximate the seat of the seal, the at least one fill/bleed channel, the first annual positioning ring, the cartridge shell, the cartridge body, and the second annual positioning ring, so that upon compression of the hydraulic fluid, by actuation of the actuator, piston, and seal

combination, within the piston cylinder at least a portion of the deformable cartridge shell deforms for mating engagement with a tool or workpiece.

22. The hydraulic cartridge of claim 19, wherein the cartridge body is also comprised of (i) a second clamping band surrounding at least a portion of the deformable inner wall and a portion of the deformable cartridge shell, (ii) a first end of the second clamping band adjacent the second annular positioning ring, the second annular positioning ring having at least one longitudinally disposed clamping channel, (iii) a third annular positioning ring adjacent a second end of the second clamping band and surrounding at least a portion of the inner wall and a portion of the cartridge shell, and (iv) a hydraulic circuit filled with hydraulic fluid, the hydraulic circuit comprised of the space bounded by that portion of the piston cylinder proximate a seat of the seal, the at least one fill/bleed channel, the first annual positioning ring, the second annual positioning ring, the at least one longitudinally disposed clamping channel in the second annual positioning ring, the cartridge shell, and the inner wall, so that upon compression of the hydraulic fluid, by actuation of the actuator, piston, and seal combination, within the piston cylinder at least a portion of the deformable inner wall and the deformable cartridge shell deforms for mating engagement with a tool or workpiece.

23. The hydraulic cartridge of claims 20 and 21, wherein the cartridge body is also comprised of (i) a second clamping band surrounding at least a portion of

the deformable inner wall or a portion of the deformable cartridge shell, (ii) a first end of the second clamping band adjacent the second annular positioning ring, the second annular positioning ring having at least one longitudinally disposed clamping channel, (iii) a third annular positioning ring adjacent a second end of the second clamping band, (iv) the second clamping band surrounding at least a portion of the inner wall and a portion of the cartridge shell, and (v) a hydraulic circuit filled with hydraulic fluid, the hydraulic circuit comprised of the space bounded by that portion of the piston cylinder proximate a seat of the seal, the at least one fill/bleed channel in the first annual positioning ring, the first annual positioning ring, the second annual positioning ring, the at least one longitudinally disposed clamping channel in the second annual positioning ring, the cartridge shell, and the inner wall, so that upon compression of the hydraulic fluid, by actuation of the actuator, piston, and seal combination, within the piston cylinder at least a portion of the deformable inner wall or the deformable cartridge shell deforms for mating engagement with a tool or workpiece.

24. The hydraulic cartridge of claim 19, wherein the seal further comprises a seat, taper, flange, piston engagement end, engagement end taper, and oil/air escape through-hole.

25. The hydraulic cartridge of claim 19, wherein the piston further comprises a seal engagement surface, compression taper, and seal compressor.

26. The hydraulic cartridge of claim 19, wherein the actuator further comprises a head cap, shoulder for engagement with a neck in the holder body, threaded portion, and contact end.

27. The hydraulic cartridge of claim 19, wherein there is a rounded surface at the junction between the bleed/fill channel and the piston cylinder for ease of insertion of a tube into the fill channel for filling the hydraulic circuit with hydraulic fluid.

28. The process of filling the hydraulic circuit of the hydraulic cartridge of claims 1 through 14 and 19 through 27, comprising the steps of:

(a) filling the hydraulic circuit with hydraulic fluid through the piston cylinder;

(b) after the hydraulic circuit is full of hydraulic fluid and air ceases to exit through the piston cylinder, inserting the seal into the piston cylinder to a minimum insertion depth in the piston cylinder so that hydraulic fluid in the piston cylinder is displaced by the seal and escapes out of the oil/air escape through-hole;

(c) inserting the piston into the piston cylinder for mating engagement of the piston pin with the oil/air escape through-hole; and

(d) inserting the actuator into the piston cylinder for engagement of the actuator contact end with the piston cap to close off the piston cylinder so that the hydraulic circuit is a closed loop.

29. The process of filling the hydraulic circuit of the hydraulic cartridge of claim 28, comprising the additional steps of:

(a) inserting a hydraulic fluid feed-tube through the piston cylinder and into the fill/bleed channel;

(b) filling the hydraulic circuit with hydraulic fluid through the feed-tube; and

(c) after the hydraulic circuit is full of hydraulic fluid and air ceases to exit through the piston cylinder, removing the tube from the piston cylinder.

30. The process of filling the hydraulic circuit of the hydraulic cartridge of claim 29, comprising the additional steps of:

(a) tilting the hydraulic cartridge at an angle from vertical during the filling process to facilitate removal of air from the hydraulic circuit and to reduce fill time; and

(b) maintaining the fill/bleed channel in the up position during the filling process.

31. The process of claim 16, wherein the insertion tool also comprises an axial bore in the insertion tube, a through pipe in communication with the bore, and a shaft attached to the insertion tube.

32. The insertion tube of claim 31, wherein the shaft has a first diameter substantially equivalent to the diameter of the piston cylinder and a through pipe transversely located in a second diameter which is less than the first diameter.

33. A cartridge comprising:

(a) a cartridge shell;

(b) surrounding a cartridge body;

(c) the cartridge body having a fluid circuit filled with fluid, a means of compressing the fluid within the fluid circuit, and at least one deformable wall so that upon compression of the fluid within the fluid circuit the wall deforms for mating engagement with a tool or workpiece within the inner bore.

34. The process of filling the hydraulic circuit of the hydraulic cartridge of claim 28, comprising the additional steps of:

(a) inserting a hydraulic fluid feed-tube through the piston cylinder and into a first of two fill/bleed channels;

(b) filling the hydraulic circuit with hydraulic fluid through the feed-tube; and

(c) after the hydraulic circuit is full of hydraulic fluid and air ceases to exit through the second of the two fill/bleed channels and into the piston cylinder, removing the feed-tube from the first fill/bleed channel and the piston cylinder.

35. The process of filling the hydraulic circuit of claim 17 also comprising the step of filling the air evacuation chamber with hydraulic fluid to a level covering the piston cylinder.

36. A hydraulic toolholder comprising:

(a) a hydraulic circuit in the outside wall of the toolholder nosepiece;

(b) a deformable outer cartridge shell affixed fluid tight around the hydraulic circuit in the nosepiece outside wall;

(c) hydraulic fluid in the hydraulic circuit;

(d) the hydraulic circuit having a piston in a piston cylinder which piston cylinder is a longitudinal piston bore extending from the insertion end of the nosepiece to the hydraulic circuit;

(e) an actuator in the piston cylinder, adjustable from the insertion end towards the hydraulic circuit, a piston moveable by the actuator, and a seal moveable by the piston through the seal displacement range, the actuator, piston, and seal in alignment with one another in the piston cylinder so that the seal is proximate to the hydraulic circuit;

(f) whereby longitudinal movement of the piston into the piston cylinder compresses the hydraulic fluid in the hydraulic circuit to outwardly deform the cartridge shell for releasable mating engagement with a bore in a tool or workpiece located around the cartridge shell.

37. A mandrel cartridge comprising:

(a) a deformable cartridge shell;

(b) surrounding a mandrel cartridge body;

(c) the mandrel cartridge body having a hydraulic circuit filled with hydraulic fluid;

(d) the hydraulic circuit having a piston in a longitudinal piston cylinder extending from the insertion end of the cartridge body to the hydraulic circuit;

(e) an actuator in the piston cylinder, adjustable from the insertion end towards the hydraulic circuit, a piston moveable by the actuator, and a seal moveable by the piston through the seal displacement range, the actuator, piston, and seal in alignment with one another in the piston cylinder so that the seal is proximate to the hydraulic circuit;

(f) whereby longitudinal movement of the piston into the piston cylinder compresses the hydraulic fluid against the deformable cartridge shell to deform the cartridge shell outwardly for releasable mating engagement with a bore in a tool or workpiece.

38. The mandrel cartridge of claim 37, also comprising a shank affixed to a first end of the mandrel cartridge in axial alignment with the first end of the mandrel cartridge shell.

39. A hydraulic mandrel holder comprising:

(a) a shank portion;

(b) a cylindrical end affixed to the shank portion in axial alignment with the shank portion;

(c) a mandrel cartridge having a deformable outer cartridge shell surrounding a cartridge body, a cylindrical end bore surrounded by an inner wall of the cartridge body, the inner wall having at least one deformable portion and configured for mating engagement with the cylindrical end;

(d) the cartridge body having a hydraulic circuit filled with hydraulic fluid;

(e) a piston cylinder extending from the insertion end of the cartridge body to the hydraulic circuit;

(f) an actuator in the piston cylinder, adjustable from the insertion end towards the hydraulic circuit, a piston moveable by the actuator, and a seal moveable by the piston through the seal displacement range, the actuator, piston, and seal in alignment with on another in the piston cylinder so that the seal is proximate to the hydraulic circuit; and

(g) so that upon compression of the hydraulic fluid within the hydraulic circuit the inner wall deforms inwardly for releasable fixed mating engagement with the cylindrical end and the deformable outer cartridge shell deforms outwardly for releasable fixed mating engagement with a bore in a tool or workpiece.

40. The hydraulic cartridge of claim 1, wherein the hydraulic cartridge also comprises a hydraulic circuit comprised of:

(a) a piston cylinder;

(b) a first annular positioning ring with the piston cylinder extending radially through the first annular positioning ring and at least one channel disposed longitudinally in the first annular positioning ring in communication with the piston cylinder;

(c) a clamping band with a first end of the clamping band adjacent the first annular positioning ring, the clamping band surrounding a portion of a deformable inner wall, and the first end of the clamping band in communication with the at least one channel; (d) a second annular positioning ring adjacent a second end of the clamping band, the annular positioning ring surrounding a portion of the inner wall; and,

(e) the inner wall surrounding and forming a tool inner bore.